WFF / LANDSAT 7 Project Interface

File Interchange Procedures

WFF File Processing Requirements

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Purpose

The purpose of this document is to define the content, format, frequency, and processing required for files exchanged between Goddard Space Flight Center/Wallops Flight Facility (GSFC/WFF) and the LANDSAT 7 (L7) project. The focus of the document is on the Wallops Orbital Tracking Information System (WOTIS), and its purpose is to define the products which WOTIS must both produce and ingest. Only the processing of files which are sent to WOTIS are addressed, although the format and exchange of all files which flow between L7 and WFF is set forth. This document is controlled by the "Interface Control Document Between Landsat 7 and the Landsat 7 Ground Network (LGN)"; much of the information herein is derived directly from the ICD.

L7 Mission Overview

The L7 System is a satellite system used to perform high resolution multispectral imaging of the Earth from a sun-synchronous, near-polar orbit. The L7 spacecraft is operated from the Mission Operations Center (MOC) at the GSFC, in Greenbelt, Maryland. Landsat 7 supports communications interfaces with the Space Network (SN), Landsat Ground Network (LGN), and International Ground Stations (IGSs) to accomplish mission goals. The components of the Landsat Ground Network are the Wallops Ground System (WGS) and the Landsat Ground Station (LGS). The WGS includes the Alaska Ground Station (AGS) located in Gilmore Creek, Alaska, the Svalbard Ground Station, located on Spitzbergen Island, Norway, and the Wallops Orbital Tracking Station (WOTS) and WOTIS, both located at Wallops Island, Virginia. The MOC receives narrowband telemetry data from the spacecraft and sends commands to the spacecraft via the LGN and the SN. Wideband science data are downlinked to the LGN and to IGSs. Data collected at the LGN sites are provided to the primary data processing facility, the L7 Processing System (LPS) located at the Earth Resources Observations System (EROS) Data Center (EDC) in Sioux Falls, South Dakota. Data collected by the IGSs are processed and maintained at these facilities. The Earth Observation System (EOS) Data Archive and Access Center (DAAC) located at the EDC provides the capabilities for users to access all of the processed L7 data, including IGS holdings. Uses for L7 data include a variety of scientific, military, and commercial applications involving global change research, national security, and civil and commercial research and planning.

L7 / WFF Interfaces

Figure 1 shows the high level interfaces for the exchange of information between L7, WFF, and the L7 Ground Station. For purposes of this document the WFF components consist of WOTIS, WOTS, and the two polar ground stations operated by WFF (the AGS and the SGS). The heavier solid lines in Figure 1 depict the flow of information relative to WOTIS. The lighter solid lines indicate information and products which flow between WFF and L7, but do not flow through WOTIS, and are not further

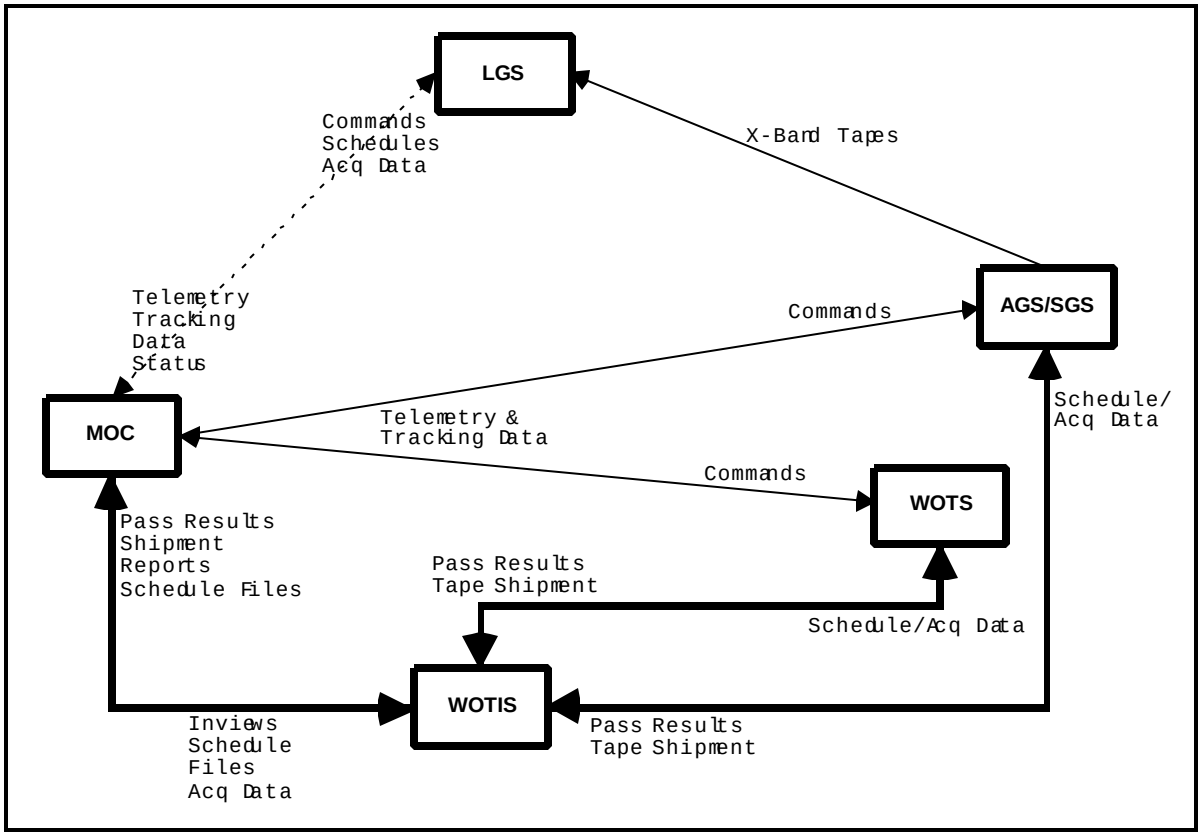

Figure 1

addressed in this document. Dashed lines indicate information flowing entirely within L7. Information which flows between the MOC and WOTIS prior to a particular support is classified as scheduling data, consisting of Inview files, Schedule files, and Acq[uisition] Data. After a support is completed, information classified as Summary Results, consisting of Pass Results files and, finally, Shipment Reports, will flow from WOTIS to the MOC.

WOTIS Overview

The Wallops Orbital Tracking Information System, known as WOTIS, is a three part system, as shown in Figure 2. It consists of the Wallops Information System Access (WISAC) subsystem, the Wallops Orbital Tracking Resource Scheduler (WOTRS), and the Wallops Information System Database (WISDB). All incoming and outgoing files pass through WISAC for direction to their proper location via FTP or Email. Some file reformatting is done in WISAC, if necessary. WISAC uses UNIX scripting so all functions are handled automatically. All incoming files, other than those which may be forwarded to another location, are sent either to WOTRS or WISDB (after reformatting, if necessary). WOTRS is the core scheduling system with the capability of scheduling n-spacecraft at m-ground stations simultaneously, employing a basic set of deconfliction algorithms, if desired. Input to WOTRS comes in the form of either a specific request file (where customers, like L7, request specific supports at specific

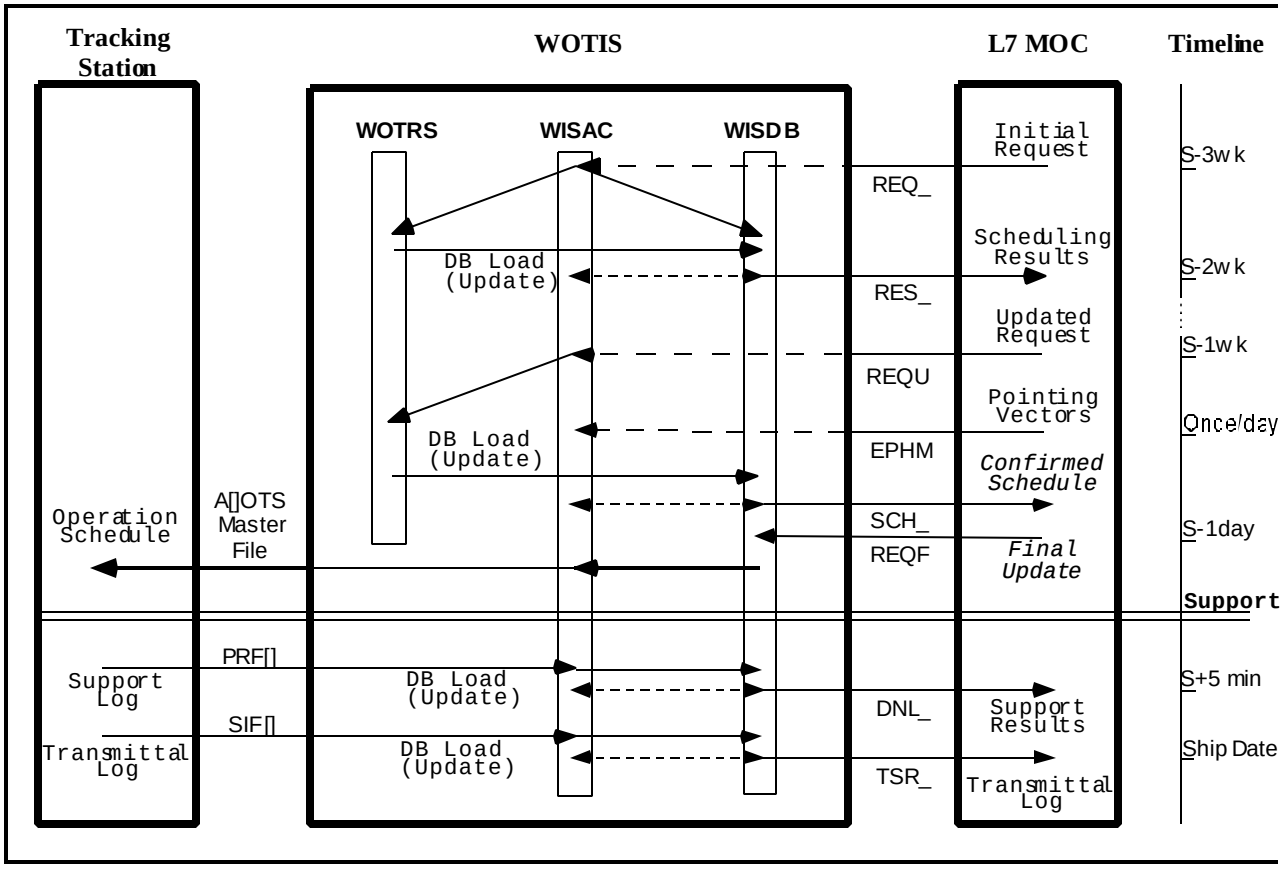

Figure 2

GS), or a viewperiod file which is supplied to the WOTRS scheduling algorithm along with some selection rules for a certain number of supports in a given time period at a list of sites, allowing the WOTRS algorithms to schedule generically by employing deconfliction to move supports to alternate sites according to the scheduling rules imposed. The complete operation of WOTRS is more fully described in a document with the title of "WOTRS", available from the WSG. The single output from WOTRS is the official "schedule" which is sent to WISDB (via WISAC). WISDB uses the WOTRS schedule to determine what is or is not scheduled at any given time at all WFF GS. All results of scheduling operations at WFF GS flow into WISDB (from WISAC), and it is from WISDB that all reporting is done to all customers (including daily and weekly schedules sent to the WFF GS).

Scheduling Data

Scheduling ground station support to meet Landsat 7 recovery needs is a responsibility of the Flight Operation Team (FOT) within the MOC. The scheduling strategy employed maximizes LGS usage and fills coverage gaps with the WGS sites. The specifics regarding LGS scheduling are not within the scope of this document; the process and specifics for WGS scheduling are as follows. Refer to Figure 2.

Approximately three weeks before the interval being scheduled, the scheduling process begins with the FOT/MOC sending a strawman request file to WOTIS. The request file, which contains the Inviews selected by the MOC for the WGS, is designated REQ_ in Figure 2. It follows the same format used in all MOC-WOTIS schedule exchanges, based on a general file containing view information for all Landsat 7 ground stations The strawman request file uses the Request/Response Format given in Appendix A. Records are included for each requested S-Band and X-Band contact. The tag field in each record is set to zero by the MOC since this value is assigned by WOTIS later in the scheduling process. The X-Band frequency is also a default value since the actual frequency is unknown until ETM+ imaging is planned. The period to be scheduled, known as the WFF Scheduling Week, is Monday, 0000z, through Sunday, 23:59:59z. However, the file covers one week plus a day of overlap on each end to allow continuity from one scheduling period to the next. Thus, each file starts at the first request after 0000z on the Sunday of the target week and ends with the last LOS eight days later (i.e. a Monday). Supports that start in one week and end in the next (e.g. Sunday 23:55:00 to Monday 00:05:00) are requested and scheduled as part of the earlier week. Due to the overlap included in each file, such supports are listed in both weeks' files.

The views for the WGS sites are filtered by the MOC based on several criteria, including coverage availability at the LGS and pass duration. These resulting views represent a more accurate prediction of actual Landsat 7 support needs and, therefore, are sent to WOTIS as the first step in the scheduling process.

Once WOTIS receives the file, a preliminary schedule, called the forecast response and designated as RES_ in Figure 2, is generated based on the Landsat 7's views and the support requirements of other WGS-supported spacecraft. This forecast schedule file, which is FTP' d to the MOC approximately 2.5 weeks before the target week, contains entries for each request that WGS resources can support. The entry types are based on defaults which represent the most common Landsat 7 support configurations. Based on agreements between WGS and the Landsat 7 project, support entries for both X-Band and S-Band are generated for SGS and AGS since two RF equipment chains are used. For WOTS contacts, only S-Band support is required, so only a single entry appears in the schedule. Since there may be a 12 minute station checkout where the MOC flows data to/from the WGS, the WSG will not allow any other S/C to be scheduled within 15 minutes of the L7 track start. The WOTIS scheduling system generates tags that are used to uniquely identify each X-Band and each S-Band support in a schedule. Any subsequent actions relevant to a given support by either the MOC/FOT or WGS make use of this tag.

Between one week and two weeks before the target week, the MOC/FOT returns a confirmed schedule to WOTIS, designated REQU in Figure 2, in response to the forecast schedule. This schedule further refines the support that Landsat 7 needs from WGS by containing only the X-Band and S-Band entries that are required to meet mission objectives. This schedule is expected to contain a subset of the coverage that was originally listed in the strawman request file initially sent to WOTIS. Entries that were in the forecast schedule but do not appear in the confirmed schedule are effectively deleted. In addition to deleting contacts, the MOC/FOT can make any necessary changes to the support entries via the confirmed schedule. For example, specific on and off times for S-Band station resources can be given

by adjusting the times associated with the contact, and tracking support can be changed from one-way to two-way or vice versa.

If further confirmation of schedules is desired (not a L7 requirement), WOTIS has the capability of producing an informational schedule, called an SCH_ in Figure 2. This is created and sent to customers requesting it on Thursday or Friday before the beginning of the WFF Operational scheduling week.

The MOC provides the requisite ephemeris information for the ground stations to acquire Landsat 7. For the WGS sites (refer to the file designated EPHM in Figure 2), the data are sent to WOTIS, and from there, distributed to the ground station control systems as part of the A[ ]OTS (ASOTS for Svalbard, APOTS for Alaska, and AWOTS for WOTS) Master Schedule (described below). For the LGS, acquisition data are sent directly to the site. The MOC provides acquisition data files each day to ensure that acquisitions occur with only minimal delays. Each file contains 48 hours' worth of data to provide continuity between files and to mitigate any risk due to communications outages.

Exceptions to the acquisition data delivery schedule are the periods following orbital maneuvers. The MOC delivers routine data incorporating the planned maneuver and its expected results. Within a matter of hours after a maneuver, the MOC may transfer new data based on tracking data collected just after the burn. If a maneuver is canceled, acquisition data may also need to be updated quickly. In this case, the file is transferred to LGS or to WOTIS for routing to the ground stations. When acquisition data need to be updated rapidly, the FOT also sends a copy of the current daily schedule to WOTIS to trigger the database to produce a new daily operational schedule for update at the WGS sites. The update ensures that the new acquisition data reaches the sites in the most expeditious manner

Each day, the MOC/FOT sends a daily schedule file to WOTIS by 2000z. The file, designated REQF in Figure 2, begins with the first support starting after 0000z and covers a 48-hour period. This schedule is based on the same format used for the other schedule files. The parameters that will be given at this time are X-Band frequency (i.e. which of Landsat 7' s three will be in use) and specific equipment on/off times. The file is entered directly into the scheduling database, WISDB, and not the scheduling system (WOTRS). Upon receipt the file triggers the creation of a daily schedule file covering the next UTC day (shown as A[ ]OTS Master File in Figure 2) for all WGS. The proper ephemeris data is added to the file immediately before transmission to the GS. As with the other transmissions, FTP provides acknowledgment that the daily schedule arrived successfully at WOTIS. The transfer of the daily schedule is the final electronic exchange in the scheduling process. Any modifications after this point, including requests for emergency support, are accomplished via voice coordination between the FOT and WGS operations staff, with confirmation via electronic mail.

Summary Results

After a support is complete at any of the Wallops Ground Stations, the A[ ]OTS Master computer assembles all results from the Nodes into a Pass Results File, designated PRF[ ] in Figure 2. Following the same logic for the A[ ]OTS Master Schedule, the fourth character in the file name designates the ground station responsible for the file. The file is created and transferred via FTP to the WISAC for entry into the WISDB within 5 minutes after the pass. For those customers requiring summary results as soon as possible after a support, as does L7, WISDB creates the DNL_ file, known as the Downlink

file, shown in Figure 2 immediately upon receipt of the PRF[ ]. Other customers desire and get only one Downlink file per day. Information contained in the PRF[ ] are: support identification tag, satellite, ground station, operation (support or playback), tape cassette volume label, start/stop address and time for data on tape, S/C orbit #, ID # of tape recorder, time bit sync achieved lock, time bit sync lost lock, percent of time bit sync remained locked relative to customer's support request, pass recorded and tracked indicator (Y/N), data quality statistics from the antenna, Programmable Telemetry Processor (PTP), and the recorder node, and, finally, comments from the WFF schedulers explaining any support anomalies. Format of the DNL_ is given in Appendix A.

When tapes are shipped from the WGS to the LGS, a tape shipment report is created at the GS for entry into WISDB, which, in turn, creates a TSR_ file for the customer. The format is given in Appendix A.

File Handling

All incoming files external to WOTIS are sent via FTP to their assigned directories on the WISAC workstation. Files from the MOC will be put into the "in" box ("in" is a subdirectory on the workstation, beneath each project or GS directory) in the LANDSAT directory, just as files from the ground stations are put into the "in" box in their own respective directories. Outgoing files are handled the same; they are created by WISDB, and forwarded to the appropriate "in" boxes for all directories on the WISAC workstation. Files placed into the "in" box are monitored for completion of the FTP Put process (file size must remain stable for 1 minute), and then removed by a UNIX cron job. Configuration files on the WISAC workstation determine the disposition of every file placed into an "in" box. Some incoming files are pre-processed by file formatting software before being sent to their proper location. Most are destined for WISDB or WOTRS where reporting and scheduling is performed.

The following steps must be taken for the proper processing L7 files from the MOC which are ingested by WOTIS, and to generate the proper files to be returned to the MOC from WOTIS.

Prior to the Support at WGS

- **Strawman Request File (REQ_) - MOC to WOTIS**
  - Ingest file
    - For each requested support at AGS/SGS, make an S-band and an X-band request using original customer request times
    - For each requested support at WOTS, make an S-band request
  - Derive station antenna track times from customer support times
    - For each orbit, find the earliest and latest support times, and subtract TBD minutes from the beginning support time and add TBD minutes to the end support time to derive the antenna tracking window
  - Output an Oracle Load file (.ORA)

        - Original customer support times should be loaded into database fields TIME_ON and TIME_OFF, and antenna track times should be loaded into fields TRACK_START and TRACK_STOP
    - Output a WOTRS Specific Request File
        - Original customer support times should be loaded into Specific Request pass-thru time fields, and antenna track times should be output as the actual times to be scheduled in WOTRS
    - Trap errors and Email Ops if any occur
- **Forecast Schedule Response File (RES_) - WOTIS to MOC**
    - File will contain all available contacts which will be supported at AGS/SGS/WOTS
    - Unique Tag # (WOTRS Line Item) is assigned to each support
    - Times output in Request/Response formatted file are original customer support times
    - File should be ordered by date/time
- **Confirmed Schedule File (REQU) - MOC to WOTIS**
    - Ingest file and output a WOTRS Specific Request File
        - For each orbit, find the earliest and latest support times, and subtract TBD minutes from the beginning support time and add TBD minutes to the end support time to derive the antenna tracking window
        - Original customer support times should be loaded into Specific Request pass-thru time fields, and antenna track times should be output as the actual times to be scheduled in WOTRS
    - Trap errors and Email Ops if any occur
- **Ephemeris File (EPHM) - MOC to WOTIS**
    - Ingest file, reformat FDF IIRV format into WOTIS Internal Ephemeris format
    - Output WOTIS Internal Ephemeris format files, one for each UTC day
    - Store files in WOTIS Ephemeris Holding Area
    - Trap errors and Email Ops if any occur
- **Daily Schedule File (REQF) - MOC > WOTIS**
    - Ingest file directly into Oracle Database
        - Supports will be matched to existing supports in database using Tag in Request/Response format
        - The only fields in the database which will be updated are TIME_ON, TIME_OFF, and BAND
    - Produce an Oracle Event Trigger file, causing the generation of an A[ ]OTS Master Schedule file
    - Trap errors and Email Ops if any occur

After the Support at WGS

- **Downlink Summary File (DNL_) - WOTIS to MOC**

  - Produce from WISDB after every support, pending receipt of PRF[ ]
  - Trap errors and Email Ops if any occur
- **Tape Shipment Report File (TSR_) - WOTIS to MOC**
  - Produce from WISDB coincident with shipment of media from WGS to LGS
  - Event is triggered by receipt of SIF[ ] from WGS
  - Trap errors and Email Ops if any occur

Testing

WFF proposes to perform incremental testing as the software components are developed and move to completion. As was the case with the ADEOS S/C (a joint USA/Japan project), and will be the case with L7, all scheduling S/W is due to be finished before completion of actual ground station hardware and software. It is not possible to perform any degree of end-to-end testing until the GS are complete, since they are a critical link in the testing process (e.g. all results data originate from a properly functioning GS). However, if incremental testing is carried out, many important problems can be discovered and corrected long before end-to-end testing is due to begin on the very ambitious timelines dictated by the launch of L7 and EOS, and the deployment of the polar ground stations. The following scenario is recommended, with approximate time frames derived from the master software development schedule maintained by the NASA Software and Analysis Group at WFF.

WOTIS / L7 Testing Scenario

1) Connectivity Test

Objective: Insure WOTIS and L7 MOC or FOT can communicate via FTP per the ICD. Files must move correctly between the two entities.

Time Frame: June, 1997

2) File Transfer Test

Objective: Insure WOTIS and L7 MOC or FOT can produce and ingest properly named files per the ICD. Information in the files will be dummy, but the format must be correct.

Time Frame: June - July, 1997

3) Scheduling / Scheduling Response Test

Objective: Produce files with correct format and content. Move through a scheduling scenario from receipt of REQ_ to production of A[ ]OTS Master file. The WOTRS scheduling system will be employed.

Time Frame: July - August, 1997

4) Pass Results Test

Objective: A dummy PRF[ ] will be generated which will be expected to produce a DNL_ of the proper format; DNL_ content will be produced manually. A tape shipment report file will be generated manually.

Time Frame: August, 1997

5) End-To-End Test Using WFF 11m Antenna

Objective: Schedule a target-of-opportunity real S-band (or S & X, if possible) satellite support, and generate all files according to the ICD.

Time Frame: August - September, 1997

6) Integration Testing at Svalbard & Poker

7) Acceptance Testing

Appendix A - File Names & Formats

Request/Response File (REQ_, RES_, REQU, REQF)

Name:

For REQ_, REQU

<type><project>WK##.**V**##

		Range	
Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	REQ_ REQU	n/a
<project>	Mission identifier	L7	n/a
WK##	Week number, two digits	01[1]	53[2]
V##	"V"ersion identifier, where ## is a two-digit counter	V00	V99

[1] Week 1 is defined as the week containing 1 January.
[2] Some years will contain 52 weeks then roll over to Week 01 while others will roll over after Week 53. This occurs because each week runs from Monday through Sunday and Week 01 may contain the end of December.

For RES_

<type><project>WK##.**V**DOYHHMM

Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	RES_	n/a
<project>	Mission identifier	L7	n/a
WK##	Week number	01[1]	53[2]
VDOY	"V"ersion identifier indicating day of year file was prepared for transmission	V001	V366
HH	Hours of day of file preparation time	00	23
MM	Minutes of hour of file preparation time	00	59

For REQF

<type><project>DOY.**V**##

		Range	
Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	REQF	n/a
<project>	Mission identifier	L7	n/a
DOY	Day of year covered by this schedule	001	366
V##	"V"ersion identifier, where ## is a two-digit counter	V00	V99

Formats:

Fields within a record (Items) are separated by a single comma and records are delimited by an ASCII newline character.

Request/Response Format

Item No.	Name	Format	Max Size (bytes)	Value(s)
1	Tag	unsigned integer	15	one of the following[1]: • zero (straw man) • ID number assigned by WOTIS
2	Project	ASCII	2	"L7"
3	Facility	ASCII	4	one of the following: • "AGS" • "SGS" • "WOTS"
4	Beginning of Track	GMT Field[2]	17	station equipment "on" time
5	End of Track	GMT Field[2]	17	station equipment "off" time
6	Activity Code	ASCII	4	one value from Activity List
7	Orbit	unsigned integer	10	value from MOC planning aids
8	Band	ASCII	2	one of the following: • "X1" = 8082.5 MHz • "X2" = 8212.5 MHz • "X3" = 8342.5 Mhz • "S1" = S-band

1. This field is set to zero in the straw man request file that the MOC sends to WOTIS. For all other schedule files, a WOTIS-generated identification number is used.
2. See GMT Time Format.

GMT Time Format
(used in Request/Response Format above)

Field: yyyy/ddd:hh:mm:ss		Format (Size): ASCII (17 bytes)	Range:
yyyy	Year	ASCII (4 bytes)	1996 through 2100
ddd	Day of Year	ASCII (3 bytes)	001 through 366
hh	Hour	ASCII (2 bytes	00 through 23
mm	Minute	ASCII (2 bytes)	00 through 59
ss	Second	ASCII (2 bytes)	00 through 59

Activity List
(used in Request/Response Format above)

Activity Code	Receive/ Record	Command	Tracking Data/ Mode	Data Forwarding
TR1	4.864 Kbps 256 Kbps	2 Kbps	2-Way/ Coherent	4.864 Kbps 256 Kbps
TR2	1.216 Kbps 256 Kbps	2 Kbps	2-Way/ Coherent	1.216 Kbps 256 Kbps
TR3	4.864 Kbps 256 Kbps	2 Kbps	1-Way/ Non-coherent	4.864 Kbps 256 Kbps
TR4	1.216 Kbps 256 Kbps	2 Kbps	1-Way/ Non-coherent	1.216 Kbps 256 Kbps
PBK	256 Kbps		None/ Non-coherent	256 Kbps
SPC[1]				

1. SPC is used for testing and other special activities. Configuration will be arranged by the FOT and WGS personnel and documented in briefing messages as needed.

Ephemeris File (EPHM)

Name:

<type><project>YYYYMMDD.**V**##

		Range	
Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	EPHM	n/a
<project>	Mission identifier	L7	n/a
YYYY	Four-digit year identifier first day in file	1996	2100
MM	Two-digit month identifier	01	12
DD	Day of month identifier	01	31
V##	"V"ersion identifier, where ## is a two-digit counter	V00	V99

Format:

Items within the file are positionally located as shown, with no delimiters. Lines are separated by 2 ASCII newline characters, followed by 2 line feed characters.

Line	Item Number	Number of bytes	Data Item	Range of Values
1	1	2	Message Type	03 = Operations Data Message
	2	7	Message Identification	A unique 7-character number used to reference this message
	3	1	Message Source	0 = FDF
	4	2	Message Class	10 = IIRV (nominal), 15 = IIRV (inflight update)
	5	5	Message Start	"GIIRV" (fixed), message start
	6	1	Originator Identification	Alphabetic character that identifies the originator of message: ASCII Space = GSFC
	7	4	Routing Indicator	NASCOP routing indicator, identifying the site from which the message was generated.
	8-9	2	Carriage Returns	Two carriage returns, refer to Appendix A of Reference 6 for the ASCII character set
	10-11	2	Line Feeds	Two Line feeds; refer to Appendix A of Reference 6 for the ASCII character set
2	12	1	Vector Type	1 = Routine on-orbit (free flight) 2 = Forced (special orbit update) 3 = Spare 4 = Maneuver ignition 5 = Maneuver cutoff 6 = Reentry 7 = Powered flight 8 = Stationary

	13	1	Data Source	1 = Nominal/planning 2 = Real-time 3 = Off-line
	14	1	Transfer Type	1 = Interrange
	15	1	Coordinate System	1 = Geocentric true-of-date rotating
	16	4	Support Identification Code	6406
	17	2	Vehicle Identification Code	1
	18	3	Sequence Number	Counter incremented for each vector in a set of vector data
	19	3	Day of year	Day of year (001 = January 1)
	20	9	Vector Epoch	HHMMSSSSS in UTC with resolution to nearest millisecond (the implied decimal point is three places from the right)
	21	3	Check Sum	Sum of the decimal equivalent of the preceding characters for items 12-20 (right- justified), where: 0-9 = face value Minus = 1 ASCII Space = 0
	22-23	2	Carriage Returns	Same as items 8-9
	24-25	2	Line Feeds	Same as items 10-11
3	26	1	Sign Character	ASCII space = Positive Minus sign = Negative
	27	12	X Position	X component of position*
	28	1	Sign Character	Same as Item 26
	29	12	Y Position	Y component of position*
	30	1	Sign Character	Same as Item 26
	31	12	Z Position	Z component of position*
	32	3	Check Sum	Sum of the decimal equivalent of the preceding characters for items 26-31 (right- justified) where: 0-9 = face value Minus = 1ASCII Space = 0
	33-34	2	Carriage Returns	Same as items 8-9
	35-36	2	Line Feeds	Same as items 10-11
4	37	1	Sign Character	Same as item 26
	38	12	X Velocity	X component of velocity**
	39	1	Sign Character	Same as item 26

	40	12	Y Velocity	Y component of velocity**
	41	1	Sign Character	Same as item 26
	42	12	Z Velocity	Z component of velocity**
	43	3	Check Sum	Sum of the decimal equivalent of the preceding characters for items 37-42 (right-justified) where: 0-9 = face value Minus = 1ASCII Space = 0
	44-45	2	Carriage Returns	Same as items 8-9
	46-47	2	Line Feeds	Same as items 10-11
5	48	8	Mass	Mass of spacecraft in kilograms with a resolution to the nearest tenth of a kilogram. The implied decimal point is one place from the right. Contains all zeros when not used.
	49	5	Cross-sectional Area	Average satellite cross-sectional area in square meters with a resolution to the nearest hundredth of a square meter. The implied decimal point is two places from the right. Contains all zeros when not used.
	50	4	Drag	Dimensionless Drag coefficient. The implied decimal point is two places from the right. Contains all zeros when not used.
	51	1	Sign Character	Same as item 26
	52	7	Coefficient of Solar Reflectivity	Dimensionless Solar Reflectivity coefficient. The implied decimal point is six places from the right. Contains all zeros when not used.
	53	3	Check Sum	Sum of the decimal equivalent of the preceding characters for items 48-52 (right-justified) where: 0-9 = face value Minus = 1 ASCII Space = 0
	54-55	2	Carriage Returns	Same as items 8-9
	56-57	2	Line Feeds	Same as items 10-11
6	58	5	End of Message	Set to ITERM
	59	1	Spare	ASCII space
	60	4	Originator Routing Indicator	Set to GCQU or GAQD
	61-62	2	Carriage Returns	Same as items 8-9
	63-64	2	Line Feeds	Same as items 10-11

7	5-11	14	Repeats portion of Line 1	Same as items 5-11 when the data block contains a second vector.
8-12	12-64	184	Second IIRV if provided	Same as items 12-64 when the data block contains a second vector.
13	5-11	14	Repeats portion of Line 1	Same as items 5-11 when the data block contains a third vector.
14-18	12-64	184	Third IIRV if provided	Same as items 12-64 when the data block contains a third vector
etc.	etc.	etc.	etc.	etc.
n	5-11	14	Repeats portion of Line 1	Same as items 5-11 when the data block contains an n^{th} vector.
n+1 to n+5	12-64	184	n^{th} IIRV if provided	Same as items 12-64 when the data block contains an n^{th} vector.

Downlink File (DNL_)

Name:

<type>_<project>DOYHH.**V**DOYHHMM

		Range	
Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	DNL_	n/a
<project>	Mission identifier	L7	n/a
DOY	Day-of-year of contact start	001	366
HH	Hour of day of contact start	00	23
VDOY	"V" ersion identifier indicating day of year file was prepared for transmission	V001	V366
HH	Hours of day of file preparation time	00	23
MM	Minutes of hour of file preparation time	00	59

Format:

Fields within a record (Items) are separated by a single comma and records are delimited by an ASCII newline character.

Downlink Format

Item No.	Name	Format	Max Size (bytes)	Meaning/Value(s)
1	Tag #	ASCII	15	Support identifier
2	Satellite	ASCII	15	S/C name/" LANDSAT7"
3	Ground Station	ASCII	10	Ground station receiving data
4	Operation	ASCII	8	" Support" or " Playback"
5	Media ID	ASCII	10	Volume label of tape[1]
6	Start Address	unsigned integer	10	Position on tape where support began
7	Stop Address	unsigned integer	10	Position on tape where support ended
8	Start Time	GMT Field[2]	17	Time when tape began to record
9	Stop Time	GMT Field[2]	17	Time when recorder stopped recording
10	Orbit	unsigned integer	10	S/C orbit number
11	Recorder ID	ASCII	10	Identifying number of recorder
12	Bit Sync Start	GMT Field[2]	17	Time when bit sync & demod both achieved lock status
13	Bit Sync Start	GMT Field[2]	17	Time when bit sync & demod both lost lock status
14	Acquisition Status	unsigned fixed decimal percent	6	% of time bit sync and demod were both in lock status within customer support request
15	Recorded	ASCII	1	Was support recorded on tape?/" Y" or " N"
16	Tracked	ASCII	1	Did antenna system track S/C?/ " Y" or " N"
17	Antenna Statistics	TBD	TBD	TBD
18	PTP Frame Statistics	TBD	TBD	TBD
19	Recorder Node Statistics	TBD	TBD	TBD
20	Comments	ASCII	60	WSG comments relative to reported support

1. If a back-up tape was used, there will be two records with the same Tag #, one for each tape used.
2. Refer to GMT Time Format in Request/Response section above

Tape Shipment Report File (TSR_)

Name:

<type>_<project>YYYYDOY.**V**DOYHHMM

		Range	
Filename Segment	**Definition**	**Minimum**	**Maximum**
<type>	File type	TSR_	n/a
<project>	Mission identifier	L7	n/a
YYYY	Year of shipment	0000	9999
DOY	Day-of-year of shipment	001	366
VDOY	"V" ersion identifier indicating day of year file w as prepared for transmission	V001	V366
HH	Hours of day of file preparation time	00	23
MM	Minutes of hour of file preparation time	00	59

Format:

Fields within a record (Items) are separated by a single comma and records are delimited by an ASCII newline character.

Tape Shipment Format

Item No.	Name	Format	Max Size (bytes)	Meaning/Value(s)
1	Tag #	ASCII	15	Support identifier
2	Satellite	ASCII	15	S/C name/" LANDSAT7"
3	Ground Station	ASCII	10	Ground station receiving data
4	Recording Type	ASCII	3	Support or Test data on tape/" SUP" , " TST" , " BEX"
5	Conveyance	ASCII	10	Identifier for box in which tapes were shipped
5	Media ID	ASCII	10	Volume label of tape[1]
6	Start Address	unsigned integer	10	Position on tape where support began
7	Stop Address	unsigned integer	10	Position on tape where support ended
8	Start Time	GMT Field[2]	17	Time when tape began to record
9	Stop Time	GMT Field[2]	17	Time when recorder stopped recording
10	Orbit	unsigned integer	10	S/C orbit number
20	Comments	ASCII	60	WSG comments relative to reported support

1. This may be either the prime of back-up tape recorded during support.
2. Refer to GMT Time Format in Request/Response section above